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NAVY-ASEE (AMERICAN SOCIETY FOR ENGINEERING EDUCATION)  
SUMMER FACULTY RES. (U) OFFICE OF NAVAL RESEARCH BOSTON  
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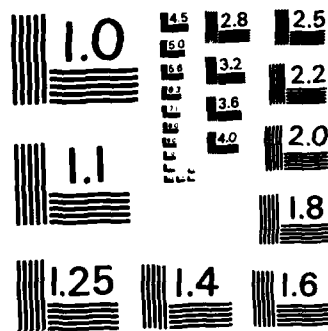
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ANNUAL REPORT  
on the  
NAVY-ASEE SUMMER FACULTY  
RESEARCH PROGRAM  
for  
1981  
with a  
CUMMULATIVE COMPILATION OF DATA ON LATER  
RESEARCH FALLOUTS  
from the  
1979 and 1980  
PROGRAMS

Robert L. Sternberg

Office of Naval Research  
Detachment, Boston  
495 Summer Street  
Boston, Massachusetts 02210

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## I. INTRODUCTION AND EXECUTIVE SUMMARY

### About the 1981 Program

*The Office of Naval Research*  
Continuing and expanding the Navy Summer Faculty Research Program (NSFRP) conducted for ONR by the American Society for Engineering Education (ASEE) previously in the summers of 1979 and 1980, the NSFRP program in 1981 brought 59 faculty members from United States colleges and universities to 10 Navy laboratories for 10 weeks cooperative summer research between the NSFRP participants and scientists at the laboratories working in areas of mutual interest to both parties.

As in the earlier years the objectives of the NSFRP program in 1981 were:

- 2-01) To engage university faculty members in the research programs of the participating Naval laboratories;
- 2-02) To develop a basis for continuing research of interest to the Navy at the participating faculty members institutions;
- 2-03) To establish continuing relations among faculty members and their professional peers in the Navy laboratories; *and*
- 2-04) To enhance the research interests and capability of the science and engineering faculty members taking part in the Navy program.

As previously the NSFRP program was conducted in 1981 by ASEE and participation was restricted to United States citizens holding teaching or research appointments in American institutions of higher education.

The 10 Navy laboratories that took part in the program during 1981 were:

Naval Research Laboratory, Washington, DC

Naval Medical Research Institute, Bethesda, Maryland

Naval Air Development Center, Warminster, Pennsylvania

Naval Coastal Systems Center, Panama City, Florida

Naval Ocean Systems Center, San Diego, California

Naval Personnel Research and Development Center,  
San Diego, California

Naval Ship Research and Development Center  
Annapolis and Carderock, Maryland

Naval Surface Weapons Center, Silver Spring, Maryland  
and Dahlgren, Virginia

Naval Underwater Systems Center, Newport, Rhode Island  
and New London, Connecticut

Naval Weapons Center, China Lake, California

The 59 faculty member participants taking part in the 1981 program were selected by the Navy laboratories from more than 300 applicants and came from colleges and universities in all parts of the United States. Included in this representation were 29 of the contiguous states, the District of Columbia, Hawaii and Puerto Rico.

Disciplines covered in the research conducted under the NSFRP program in 1981 ranged from medical and personnel research to topics in physics, chemistry, computer science and the several branches of engineering and applied mathematics and statistics. The selection of topics varied at each Navy laboratory to suit the specific areas of research within the individual laboratories charter assignments while at the same time being chosen so as to be of interest also to the faculty member participants.

Virtually all of the NSFRP participants in 1981 held the Ph.D. or an equivalent degree in their field of expertise and approximately 40 percent were assistant professors. Some 26 percent were women or members of minority groups including representatives of almost all categories of the latter. Engineering was the dominant field of the participants at 39 percent followed by the physical sciences at 27 percent and the mathematical sciences at 20 percent with the remainder in the life science areas. The ages of the participants ranged from 27 to 63, although more than half were between 35 and 45 years of age, the average age working out to be 42.

The 1981 NSFRP participants were paid stipends of 4500 dollars for their 10 weeks tenure at their host Navy laboratory plus suitable allowances for travel. The total cost to the Navy of the 1981 program was about 338,500 dollars. Somewhat more than two-thirds of these funds

were provided by ONR while the balance came from the individual Navy laboratories on an agreed prorated basis; more particularly each Laboratory was assigned from 3 to 7 NSFRP participants funded by ONR and was allowed to take at its option an additional number to be paid for out of its own funds, the actual number of such additional appointments in the event ranging from zero at several of the laboratories to 10 extra at the Naval Research Laboratory.

Many favorable and even glowing comments and expressions of enthusiasm for the program were received by ASEE and the writer regarding the experiences of the participants and their host Navy laboratories in 1981 and previous years and -- aside from a few minor difficulties experienced at one or two of the laboratories in timely establishment of clearances for a few of the NSFRP participants and a fairly commonly expressed desire by the participants for more remunerative stipends -- ASEE and the writer found no significant problems with administration of the program or with its reception by the individual participants and Navy laboratories involved.

At the end of the summer each NSFRP participant prepared a report on his summer's research at his host Navy laboratory. Abstracts of 56 of these reports are presented later in this document and it is anticipated that many of these will eventually be further developed into professional research papers appearing in the archival scientific literature. Abstracts for the 3 remaining reports on the 1981 program were delayed for various reasons and were not available in time to be included here.

Finally, before the NSFRP participants departed to return to their home colleges and universities, an appropriate certificate was presented to each of them by the Navy and ASEE in recognition of their participation in the 1981 program.

#### Fallouts from the 1979 and 1980 Programs

A number of interesting "research fallouts" as we term them of Navy significance have occurred as a result of the 1979 and 1980 NSFRP programs. Among these it is noteworthy that from the two former programs involving a total of 16 NSFRP participants at 3 Navy laboratories in the summer of 1979 and involving 26 NSFRP participants at 7 Navy laboratories in the summer of 1980, a total of:

- o 12 Research contracts adding up to 290,000 dollars have been awarded to 9 former NSFRP participants for follow on research;
- o 5 Former participants have been further employed by their host Navy laboratory on intergovernment personnel act



or exempt part-time civil service appointments and one such former participant has become a full-time civil servant at his host laboratory;

and

- o At least 14 papers based on, or continuing, research started under the NSFRP programs have been presented as invited or contributed papers at scientific and engineering meetings of Navy interest and/or have been published in refereed journals or in the conference proceedings of such meetings.

Clearly these accomplishments go a long way towards demonstrating the success of the NSFRP programs in meeting the Navy's objectives set forth earlier.

#### Organization of the Report

Additional items of interest, factual data, more information on costs and more detailed statistics regarding various aspects of the 1981 NSFRP program are provided in Section II.

The abstracts of the individual NSFRP participants reports on their 10 weeks summer research are presented in Sections III through XII, one section being devoted to each of the ten participating Navy laboratories and full reports, on individual projects can, incidentally, be provided by the writer or ASEE, if desired.

The cumulative compilation of data on the later or subsequent "research fallouts" of Navy interest which have resulted from the 1979 and 1980 NSFRP programs is presented in some detail in Section XIII.

Finally, a brief outline of plans for the 1982 NSFRP program and plans for continued tracking of future NSFRP program research fallouts are set forth in Section IV.

#### Acknowledgements

The writer is indebted to Robert D. Ryan and Nicholas Perrone of ONR for many helpful suggestions and other assistance with administration of the 1981 NSFRP program and wishes to express his appreciation for their efforts. He is also indebted to, and wishes to thank, F. X. (Tim) Bradley of ASEE for carrying out all the many and varied duties of Program Director for the 1981 NSFRP program for ONR and ASEE. Thanks also are due the Program Coordinators at the 10 Navy laboratories and the Navy scientists and the 59 NSFRP participants that took part in the 1981 program; their names appear later on in this report and their collective help, advice and assistance is herewith acknowledged with pleasure.

## II. MANAGEMENT, PERSONNEL, STATISTICAL DATA AND COSTS FOR THE 1981 PROGRAM

### Administration and Program Execution

The NSFRP program in 1981 was again administered by ASEE for ONR. F.X. (Tim) Bradley, Jr. served as Project Director for the program at ASEE and the writer served at ONR as Scientific Officer.

The 1981 program was advertised by ASEE in the fall of 1980. Announcements of the program were sent to more than 40,000 members of ASEE and the American Association for the Advancement of Science. In addition, announcements were sent separately to about 12,000 deans and department chairpersons in American colleges and universities including coverage of departments of mathematics, physics, chemistry, astronomy, geology, geography, information and communication sciences, statistics, atmospheric and hydrospheric sciences, general sciences, and the social and economic sciences.

Applications received at ASEE in response to the announcements were forwarded to the 10 Navy laboratories, distributed according to the preferred first choice Navy laboratory indicated by the applicants. These were then circulated at each Navy laboratory to find appropriate matches of talents and interests following which the Navy laboratories made their selections and winning applicants were offered appointments to the program by ASEE.

At each of the Navy laboratories a Program Coordinator acted as a focal point for local administration of the program and each NSFRP participant was associated, at the Navy laboratory to which he was assigned, with one or more selected Navy scientists -- referred to in this report as the participant's Research Colleagues.

Preprogram visits of the 59 participants to their assigned Navy laboratory were arranged in order to plan the participant's summer research, make preliminary arrangements for their association with the Navy laboratory during the summer and to facilitate finding of suitable housing for the participants and their dependents and so forth. These preprogram visits to the participants' Navy laboratories permitted a "running start" on the participants' research in many cases and facilitated efficient use of the participants' and their Research Colleagues' time and energy for the program.

At the end of their ten weeks tenure at their assigned Navy laboratory the participants each received a certificate from ONR and ASEE attesting to his or her successful participation in the 1981 program and each participant prepared a report on his or her summer's work, abstracts of which appear in this report in Sections III through XII as noted previously.

### Personnel in the 1981 Program

The address for F.X. (Tim) Bradley, Jr., the Program Director at ASEE and the names and affiliations of the Program Coordinators at the 10 Navy laboratories taking part in the program in 1981 are listed below:

F.X. (Tim) Bradley, Jr.  
American Society for Engineering Education  
Suite 200  
11 Dupont Circle  
Washington, DC 20036

David A. Patterson  
Naval Research Laboratory

V. D. Schinski  
Naval Medical Research Institute

Henry Beyer  
Naval Air Development Center

John Wynn  
Naval Coastal Systems Center

Eugene P. Cooper  
Naval Ocean Systems Center

Bernard Rimland  
Naval Personnel Research and  
Development Center

Elizabeth Cuthill  
Naval Ship Research and  
Development Center

Wendell Anderson  
Naval Surface Weapons Center

Paul Scully-Power  
Naval Underwater Systems Center

Dick Wisdom  
Naval Weapons Center

The names and addresses of the participants themselves as well as the names of their Research Colleagues at the Navy laboratories appear on the abstracts of their reports in Sections III through XII and additional statistical information on the participants is presented along with other data in the following paragraphs.

Some Statistics for the 1981 Program

The 59 NSFRP program participants in 1981 -- 40 of whom were supported by ONR under the basic program and 19 of whom were supported by the Navy laboratories -- were distributed amongst the latter as shown in Table I.

Table I

DISTRIBUTION OF 1981 NSFRP PARTICIPANTS  
AT THE NAVY LABORATORIES

<u>Navy Laboratory</u>	<u>Funded by ONR</u>	<u>Funded by Laboratory</u>	<u>Total</u>
NRL	7	10	17
NMRI	3	0	3
NADC	3	0	3
NCSC	3	0	3
NOSC	4	0	4
NPRDC	3	3	6
NSRDC	5	2	7
NSWC	3	1	4
NUSC	4	3	7
NWC	<u>5</u>	<u>0</u>	<u>5</u>
Totals	40	19	59

Indicated separately therein also are the number of participants supported at each Navy laboratory by ONR and the number supported by the Navy laboratories themselves.

The names of the 1981 program participants arranged in alphabetical order along with their ages, academic ranks, departmental affiliations and home colleges or universities and the Navy laboratories at which they spent the summer are listed similarly in Table II below.

Table II

## 1981 NAVY SUMMER FACULTY RESEARCH PROGRAM PARTICIPANTS

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Ahrnsbrak, W.	39	Assoc Prof	Geoscience	Hobart & Wm Smith	NUSC
Anderson, P.A.	30	Asst Prof	Social Sci	Carnegie-Mellon	NPRDC
Baratta, A.J.	36	Asst Prof	Nuc Engineering	Penn State	NRL
Barber, P.	39	Assoc Prof	Chemistry	Longwood	NSRDC
Busby, H.R.	43	Asst Prof	Mech Eng & Appl Mech	ND State	NUSC
Campbell, D.J.	33	Asst Prof	Management	Bowling Green	NPRDC
Carroll, R.L.	36	Assoc Prof	Elec Eng & Comp Sci	GWU	NRL
Chattergy, R.	40	Full Prof	Elec Engineering	Hawaii	NOSC
Church, C.K.	29	Asst Prof	Mathematics	UN Florida	NSCS
Cook, T.M.	50	Full Prof	Microbiology	U Maryland	NMRI
Cooper, P.B.	45	Asst Prof	Civ Engineering	KS State	NUSC
Drake, A.D.	36	Asst Prof	Elec Eng & Comp Sci	U Connecticut	NUSC
Dwass, M.	58	Full Prof	Mathematics	Northwestern	NRL
Eoll, J.G.	38	Asst Prof	Physics & Earth Sci	Lenoir-Rhyne	NSWC
Ferguson, E.J.	56	Full Prof	Ind Eng & Management	OK State	NPRDC
Fleishman, L.I.	30	Asst Prof	Physics	OK State	NRL
Funk, K.H.	28	Asst Prof	Ind & Gen Engineering	OR State	NPRDC
Garcia, S.R.	38	Asst Prof	Maritime Systems Eng	TX A&M	NRL
Giles, C.L.	35	Asst Prof	Elec & Comp Eng	Clarkson	NRL
Hagelberg, M.P.	48	Full Prof	Physics	Wittenberg	NRL

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Hattfield, F.J.	39	Assoc Prof	Civ Engineering	MI State	NSRDC
Heath, A.	46	Assoc Prof	Biology	VPI	NOSC
Horan, S.	27	Instructor	Elec & Comp Eng	NM State	NRL
Howard, B.	61	Full Prof	Mathematics	Miami	NUSC
Johnston, L.H.	63	Full Prof	Physics	U Idaho	NWC
Joshi, M.	41	Assoc Prof	Eng & Physics	Coppin State	NSRDC
Kalata, P.	41	Asst Prof	Elec & Comp Eng	Drexel	NADC
Korbly, L.J.	41	Asst Prof	Mathematics	U Alabama	NSRDC
Kurtz, L.A.	41	Assoc Prof	Mathematics	Montevallo	NSRDC
Lada, C.J.	32	Asst Prof	Astronomy	U Arizona	NRL
Lee, J.C.	36	Assoc Prof	Math & Comp Sci	Moravian College	NCSC
Lane, D.	45	Assoc Prof	Chemistry	U Virginia	NWC
LeBlanc, L.R.	42	Full Prof	Ocean Eng	URI	NUSC
Linz, A.	55	Sr Res Assoc	Elec Eng & Comp Sci	MIT	NRL
MacIntyre, F.	51	Research Prof	Oceanography	URI	NUSC
Manka, C.K.	43	Full Prof	Physics	Sam Houston	NRL
Marchand, A.P.	41	Full Prof	Chemistry	U Oklahoma	NWC
Martinez, T.T.	35	Asst Prof	Pharmacology	NE Louisiana	NMRI
McLauchlan, R.A.	39	Asst Prof	Mech Engineering	TX Tech	NOSC
Mikesell, R.P.	53	Assoc Prof	Mech Engineering	U S Dakota	NRL

## RARE EARTH SOLID STATE LASER DEVELOPMENT

Arthur Linz

Department of Electrical Engineering and Computer Science  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

### ABSTRACT

An efficient, compact cavity for optically pumped rare earth solid state lasers capable of being gas cooled to 100°K was developed. An indium seal to the laser rod permits operation and easy interchange to relatively fragile fluoride laser rods without the damage problems encountered with other sealing methods. Prototype cavities for use in other experiments have been designed and are being fabricated. Preliminary experiments have identified the most efficient pump bands for low temperature operation of  $\alpha\text{SYLF:Ho}$  lasers.

Research Colleague at NRL: R. Eckardt

## HIGH VELOCITY GAS MOTION NEAR AFGL 961

Charles J. Lada

Steward Observatory  
University of Arizona  
Tucson, Arizona

### ABSTRACT

Detailed  $^{12}\text{CO}$  observations of the high velocity molecular flow around AFGL 961 are reported and analyzed. High velocity CO emission is found to have a maximum extent of at least 5 arc-minutes or 2.4 parsecs at the distance of AFGL 961. The flow is found to be anisotropic, with red shifted high velocity emission considerably more extended than blue shifted high velocity emission. In addition the emission profiles are found to be asymmetric in velocity such that the integrated intensity of the red-shifted high velocity emission is on average 2.5 times greater than that of the blue-shifted gas. The mass of the gas involved in the flow is determined to be approximately 17  $M_{\odot}$ , and the kinetic energy of this gas is estimated to be about  $4 \times 10^{46}$  ergs. These observations are taken as evidence that an energetic bipolar outflow of molecular gas is occurring near AFGL 961. The momentum of the outflowing molecular gas is large and it is shown that this places strong constraints on possible physical mechanisms which may be driving the outflow. Analysis of infrared recombination line data indicates a visual extinction of more than 70 magnitudes toward the central object. Comparison of the infrared recombination line data, with radio continuum data and our CO observations is made in order to quantitatively investigate the possibility that the source of the energetic molecular outflow is a strong stellar wind with an ionized component which produces the observed radio continuum and infrared recombination line emission.

Research Colleague at NRL: Philip Schwartz



## IMAGE COMPRESSION USING SPARSE MATRIX TECHNIQUES

Sheila Horan

Department of Electrical and Computer Engineering  
New Mexico State University  
Las Cruces, New Mexico

### ABSTRACT

Sparse image data compression techniques are considered to minimize image storage. Concentration is focused on data packing and PDQ transform methods. A comparison of the different techniques is conducted to find the best storage scheme for sparse images using matrix storage techniques.

Research Colleague at NRL: Igor Jurkevich

A SMALL PRESSURIZED CHAMBER FOR LOW FREQUENCY  
CHARACTERIZATION OF ACOUSTIC MATERIALS

M. Paul Hagelberg

Department of Physics  
Wittenberg University  
Springfield, Ohio

ABSTRACT

A system has been developed for measuring the acoustic properties of materials in water. The system makes use of digital data acquisition and analysis techniques and transducer arrays to cover the frequency range down to about 10 kHz and at pressure to above 100 psi in a compact vessel. Physical and electronic features of the system are given together with the procedures by which the sound speed and attenuation and related characteristics of the sample are determined. Results are presented for a silicone rubber, a filled silicone rubber, and the commercial material Sorbothane.

Research Colleague at NRL: Bob Corsaro

COHERENT OPTICAL PATTERN RECOGNITION  
VIA THE THEORY OF MOMENTS

C. Lee Giles

Department of Electrical and Computer Engineering  
Clarkson College  
Potsdam, New York

ABSTRACT

A finite number of moments or moment invariants of an image can be utilized to characterize that image and distinguish it from other images. Optical generation and detection of these moments is of current interest for optical pattern recognition. A coherent optical processor is described which is capable of generating moments and moment invariants based on many different moment basis sets. Different classes of moments are compared with regard to their invariant properties.

Research Colleague at NRL: Ray Patten

A SYSTEM DEVELOPMENT OVERVIEW  
FOR  
SPACE CRAFT REMOTE SENSING BATHYMETRY

Salvador R. Garcia

Department of Maritime Systems Engineering  
Texas A & M University at Galveston  
Galveston, Texas

ABSTRACT

A number of studies are currently being conducted in an effort to develop spacecraft remote sensors capable of providing hydrographic data that can improve bathymetric charts. Techniques for the exploitation of data derived from existing sensors include the development of algorithms for processing imagery from Multispectral Scanners (MSS), and Synthetic Aperture Radar (SAR). Other sensor products under consideration include data from infrared (IR), active and passive microwave, magnetic and gravity field, sensors. The thrust of these studies is to provide useful techniques that can improve nautical maps using existing data sources. Once this capability has been achieved the emphasis will turn to development of future sensor algorithms that will provide higher performance in hydrographic measurements. Sensor exploitation is seen as one definite goal at the existing data source level, and ultimately as a goal in the establishment of requirements for the design of future spacecraft sensor systems. This paper discusses these sensor exploitation concepts and provides a brief overview of on-going studies, as well as a brief discussion of the end-to-end system design considerations.

Research Colleague at NRL: V. E. Noble

# MAGNETIC FIELD INDUCED EXPANSION OF $\text{CeAl}_3$

Lawrence I. Fleishman

Department of Physics  
Oklahoma State University  
Stillwater, Oklahoma

## ABSTRACT

Experimental data shows that  $\text{CeAl}_3$  expands in the presence of a magnetic field. Over a wide range of magnetic fields, the volume obeys the law  $V(T,M) - V(T,0) = AT + BM^2$  where  $T$  is the temperature,  $M$  the magnetization, and  $A$  and  $B$  are constants.  $\text{CeAl}_3$  is usually thought of as a mixed valence compound, of which the periodic Anderson model is believed to be a good description. We have investigated various versions of this model and find they do not reproduce the temperature independent coefficient of the  $M^2$  term. A Landau free energy expansion is found to explain the volume effect but gives an incorrect answer for the susceptibility. Future calculations based on these results are discussed.

Research Colleague at NRL: Norman Koon

STATISTICAL DECISION THEORY IN RADAR SETTINGS

Meyer Dwass

Department of Mathematics  
Northwestern University  
Evanston, Illinois

ABSTRACT

An examination was made of the methods of statistical decision theory as they might apply to gathering information about airborne platforms from radar, ESM and other communication sources.

Research Colleague at NRL: Ben Comtrell

ADAPTIVE IDENTIFICATION, CONTROL AND STABILITY  
OF TIME-DELAY SYSTEMS

Robert L. Carroll

Department of Electrical Engineering and Computer Science  
George Washington University  
Washington, DC

ABSTRACT

An expanded, alternative proof of a Liapunov function for continuous time-delay systems is given. Based upon the theorem of stability, a real time identification algorithm and a model-reference adaptive control system are derived for time-delay systems.

Research Colleague at NRL: K. T. Alfrend

EFFECT OF HYDROGEN ON ELECTRON SCATTERING IN COPPER:  
DEVELOPMENT OF SAMPLE PREPARATION TECHNIQUE

Anthony J. Baratta

Department of Nuclear Engineering  
Pennsylvania State University  
University Park, Pennsylvania

ABSTRACT

Hydrogen forms interstitial alloys with metals. Research on such systems has recently received considerable attention because of the possible use of metal hydrides for the storage of hydrogen "fuel" and the effect of hydrogen on the superconducting properties of certain materials. While much experimental and theoretical work has recently been performed on metal-hydrogen systems, the electronic structure of such systems is still not completely understood. Thus, a program was undertaken for the investigation of the effect of hydrogen on the electronic structure of a well-characterized metal, namely, copper. Since hydrogen is essentially insoluble in copper at or below room temperature, a technique to load the copper samples at elevated temperature and then quench in the hydrogen is required. The research work at NRL under the NSFRP program was directed toward the development of such a method. The technique developed uses induction heating of the pure copper samples to 500°C, a subsequent annealing in a hydrogen atmosphere, and a rapid quenching to below -130°C. The quench is accomplished by dropping the sample into an isopentane quench bath maintained at -160°C.

Research Colleague at NRL: A. C. Ehrlich



III. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL RESEARCH LABORATORY

Washington, DC

Program Coordinator at NRL: D. A. Patterson

NPRDC	18.1	15.6	33.7
NSRDC	30.1	10.4	40.5
NSWC	18.1	5.2	23.3
NUSC	24.1	15.6	39.7
NWC	<u>30.1</u>	<u>0</u>	<u>30.1</u>
Totals	241.0	97.5	338.5

The proportionately higher funding of 241,000 dollars provided by ONR for the basic 40 participants as compared to the 97,500 dollars provided by the Navy laboratories for the extra 19 participants indicated by the tabulated figures reflects the basic overhead costs at ASEE for advertising and organizing the program while the nominal basic charge of 5200 dollars to the Navy laboratories per extra participant for the 19 extra people was based solely on the participants' stipend of 4500 dollars plus their travel allowances estimated to average 700 dollars per person, with as noted above, some slight adjustments in certain special cases.

In connection with these statistics it may be noted also that for the 1981 program, approximately 40 percent of the participants were assistant professors and 95 percent held the doctoral degree in their field of expertise. Engineering was the dominant discipline at 39 percent followed by the physical sciences at 27 percent and the mathematical sciences at 20 percent. Almost all areas of the country were represented with the 59 participants coming from 54 institutions located -- as noted earlier -- in 29 of the contiguous states, the District of Columbia, Hawaii and Puerto Rico.

#### Costs and Distribution of Support

The full cost to the Navy for the 1981 NSFRP program was approximately 338,500 dollars as noted. Of this ONR provided about 241,000 dollars for 40 participants and the Navy laboratories provided about 97,500 dollars for the 19 extra participants shown earlier in Table I. Since not all of the Navy laboratories desired to have more participants than could be paid for by ONR the Navy laboratory contribution came, of course, only from those Navy laboratories which actually took the extra participants.

The approximate distribution of the Navy's costs for the 1981 NSFRP program between ONR and the 10 participating Navy laboratories corresponding to the distribution of participants shown in Table I is set forth in Table III below. The contribution of each Navy laboratory that elected to take extra participants was based on a nominal figure of 5200 dollars times the number of such extra participants with appropriate minor adjustments in this allocation in one or two cases where a lesser figure applied because of special circumstances in those cases.

Table III

#### APPROXIMATE PRORATED DISTRIBUTION OF 1981 NSFRP PROGRAM COSTS AT THE NAVY LABORATORIES IN THOUSANDS OF DOLLARS

<u>Navy Laboratory</u>	<u>Cost to ONR</u>	<u>Cost to Laboratory</u>	<u>Total Cost</u>
NRL	42.1	50.7	92.8
NMRI	18.1	0	18.1
NADC	18.1	0	18.1
NIUSC	18.1	0	18.1
NOSC	24.1	0	24.1

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Reneke, J.A.	44	Assoc Prof	Math Science	Clemson	NCSC
Riesbeck, C.K.	34	Sr Res Assoc	Comp Sci	Yale	NPRDC
Rivera, L.A.	33	Instructor	Chemistry	U Puerto Rico	NSWC
Rubin, R.A.	37	Asst Prof	Mathematics	Whittier	NADC
Samuel, A.	44	Assoc Prof	Biology	St. Paul's	NMRI
Sasaki, E.H.	41	Full Prof	Psychology	CA State	NPRDC
Schmiedekamp, C.	34	Asst Prof	Math Science	Drexel	NADC
Schumpert, J.M.	42	Asst Prof	Elec Engineering	U Virginia	NRL
Shelton, W.W.	40	Asst Prof	Elec & Comp Eng	FL Institute Tech	NSWC
Shubeck, P.P.	55	Full Prof	Biology	Montclair	NRL
Sung, C.C.	45	Full Prof	Physics	U Alabama	NWC
Syed, V.	34	Asst Prof	Elec Engineering	U Michigan	NSWC
Tamaki, J.K.	27	Asst Prof	Mathematics	Santa Clara	NOSC
Taylor, T.D.	40	Assoc Prof	Ceramic Eng	Clemson	NRL
Thomas, J.J.	41	Instructor	Mathematics	U Missouri	NSRDC
Vietti, M.A.	40	Assoc Prof	Physics	U Maine	NRL
Walmsley, J.A.	45	Sr Res Assoc	Chemistry	Toledo	NRL
Walsh, P.J.	52	Full Prof	Physics	Fair'1 Dickinson	NWC
Yuschik, M.J.	37	Asst Prof	Elec & Comp Eng	U South Carolina	NSRDC

# THE 227.1nm C V EMISSION LINE IN LASER-PRODUCED CH PLASMA

C. K. Manka

Department of Physics  
Sam Houston State University  
Huntsville, Texas

## ABSTRACT

The 227.1nm C V line has been observed in the emission spectra from a laser produced CH plasma. The NRL PHAROS laser provided a 4ns pulse at 1.06 micron having a total energy of about 170j. The spot size was 300 microns and intensities were on the order of 10 watts/cm<sup>2</sup>. This particular line was identified as especially useful for the determination of magnetic fields using the Zeeman effect because of its very low Stark broadening. The 227.1nm line was observed in two polarizations and examined for a polarization dependent width which would indicate the presence of large magnetic fields.

Research Colleague at NRL: Steven Bodner

THE BEHAVIOR OF TEN TITANIUM ALLOYS TESTED AS  
PRE-CRACKED CHARPY SAMPLES IN THREE-POINT BENDING

Ritchie P. Mikesell

Department of Mechanical Engineering  
University of South Dakota  
Brookings, South Dakota

ABSTRACT

A preliminary evaluation has been made of the significance of toughness values derived from tests on Charpy pre-cracked impact samples. The inexpensive charpy type of test has the potential to yield meaningful results.

Research Colleagues at NRL: B. B. Rath and R. W. Judy, Jr.

STUDIES IN ON-BOARD SIGNAL PROCESSING FOR  
SPREAD-SPECTRUM SATELLITE COMMUNICATIONS

J. M. Schumpert

Department of Electrical Engineering  
University of Virginia  
Charlottesville, Virginia

ABSTRACT

Signal processors for on-board demodulation and acquisition of frequency-hopped signals were investigated. The design approaches for each processing function were constrained due to spacecraft weight and power limitations. For the demodulation processor, a hybrid configuration was recommended. This consisted of a bank of analog filters followed by Fast Fourier Transform (FFT) tone detectors. Tradeoffs between the number of analog filters, FFT length, and sampling rates were considered. For the acquisition problem a five-point correlation algorithm was studied as a possible alternative to conventional techniques. Performance of this algorithm was determined both analytically and via a computer simulation.

Research Colleague at NRL: Peter MacGahan

TERRESTRIAL CHEMOSENSING: AN INSECT MODEL

Paul P. Shubeck

Department of Biology  
Montclair State College  
Upper Montclair, New Jersey

ABSTRACT

The carrion beetle Silpha americana was found to be strongly attracted to carrion-baited traps and to be active from 15 June 1981 to 3 August 1981. It was the most abundant species of Silphidae during this period of time. Silpha americana is a large beetle, easy to handle with forceps in the field and in the laboratory. It was found to be reasonably successful in locating carrion under 1, 2, and 3 cm of sand. The rate of success for the entire family (Silphidae) was found to be very similar to that of Silpha americana.

Research Colleague at NRL: D. L. Blank



INFLUENCE OF SURFACE GRINDING ON THE FRACTURE  
ENERGY OF FUSED QUARTZ

Theodore D. Taylor

Department of Ceramic Engineering  
Clemson University  
Clemson, South Carolina

ABSTRACT

The effect of surface grinding on fracture energy of fused quartz was investigated. Using the Applied Moment Double Cantilever Beam (AMDCB) technique, crack velocity measurements were conducted as a function of the stress intensity factor for both annealed and "as-machined" specimens. The data suggest that there is no significant difference between the two treatments. Significant differences might occur if the annealing process were conducted at a higher temperature and for a longer time.

Research Colleague at NRL: C. C. M. Wu and R. W. Rice

CHECKOUT AND TESTING OF A RUNWAY VISUAL  
RANGE/CLOUD BASE HEIGHT APPARATUS

Michael A. Vietti

Department of Physics  
University of Maine at Orono  
Orono, Maine

ABSTRACT

The primary objective was to operate, for the first time, a Runway Visual Range/Cloud Base Height (LIDAR) System and to test the apparatus in a coastal environment to obtain cloud height, visibility and scattering coefficients. After testing at both NRL and Corea, Maine, the equipment demonstrated the ability to determine infog visibility. However, we were unable to receive return signals from clouds well within the range of the instruments design capability. It was subsequently found that the output power of the infra red laser source was less than 5 percent of the design maximum value. Follow up development of the system is in progress.

Research Colleague at NRL: Lothar Ruhnke

TRANSITION METAL COMPLEXES AS POSSIBLE CATALYSTS FOR  
THE REDUCTION OF CARBON DIOXIDE

Judith A. Walmsley

Department of Chemistry  
University of Toledo  
Toledo, Ohio

ABSTRACT

The purpose of the project was to find a suitable homogeneous catalyst for the reduction of carbon dioxide by hydrogen. Numerous transition metal compounds, frequently containing the transition metal in a low oxidation state, are capable of reversibly binding  $\text{CO}_2$  and are likely candidates for the activation of  $\text{CO}_2$  toward reaction with  $\text{H}_2$ . Two systems have been investigated: copper(II) methoxide in methanol-pyridine solvent and nickel (0)-phosphino complexes. At least two different species containing carbon dioxide or carbonate are formed with  $\text{Cu(II)}$  methoxide, but in only one of these does the binding of  $\text{CO}_2$  appear reversible. The  $\text{CO}_2$ -containing compounds were characterized and their reactions with hydrogen were investigated.

Research Colleague at NRL: J. C. Cooper

IV. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL MEDICAL RESEARCH INSTITUTE

Bethesda, Maryland

Program Coordinator at NMRI: V. D. Schinski

ELASTASE AS A VIRULENCE FACTOR IN AEROMONAS:  
ISOLATION OF ELASTASE DEFICIENT MUTANTS OF A. SOBRIA  
AND TESTS ON VIRULENCE

Thomas M. Cook

Department of Microbiology  
University of Maryland  
College Park, Maryland

ABSTRACT

Four elastase deficient mutants were selected from A. sobria NMRI 3 after ultraviolet irradiation. These all retained cytotoxin and hemolysin activity. Mouse virulence tests were inconclusive, but suggested a possible slight decrease in virulence for three of these mutants (E-3, E-4 and E-5). No differences between the cultures were observed for most biochemical characteristics, except that E-3 showed only a very weak VP test and did not grow in KCN broth.

Research Colleague at NMRI: Richard Walker

THE EFFECT OF LIDOCAINE ON AIR EMBOLISM  
IN CAT CEREBRAL VESSELS

Terry T. Martinez

School of Pharmacy  
Northeast Louisiana University  
Monroe, Louisiana

ABSTRACT

Experiments on the effects of lidocaine on the changes in cerebral circulation that occur following air embolisms were conducted and subjected to initial analysis. Further analysis of the data will be conducted at a later date.

Research Colleague at NMRI: Delbert Evans

SURFACE ANTIGEN PATTERN OF A SELECTED IN VITRO  
T CELL LINE AND THE CORRELATIONS BETWEEN THE  
EXPRESSION AND FORMATION OF CELL SURFACE  
ANTIGENS AND SPECIFIC CELL CYCLE PHASES

Albert Samuel

Department of Science and Mathematics  
Saint Paul's College  
Lawrenceville, Virginia

ABSTRACT

The surface antigen pattern of a Leukemic T-cell line (Jurkat) was studied using a panel of antibodies. A possible relationship between cell cycle phase and the specific expression and formation of the relevant cell surface antigens was investigated by assaying synchronized cell samples collected at selected time intervals post release of cells from G1-S block. Double cell block was employed by the treatment of cells with Colcemid (mitotic block) and Hydroxyurea (G1-S boundary block). The antibody-antigen binding was assayed by using fluorescein conjugated goat-antimouse and analysing the fluorescence pattern generated by a fluorescence-activated cell sorter using an on-line computer. Positive reactions were observed in several cases. A strong possibility of cell cycle related behavior of antigen expression was indicated for one of them. Configuration of the results by repeated experimentation is warranted. One of the main difficulties encountered in this project was preparing well dispersed cells for transmission through the flow system. This problem will be given priority during the coming year.

Research Colleague at NMRI: J. Maples

V. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL AIR DEVELOPMENT CENTER

Warminster, Pennsylvania

Program Coordinator at NADC: Henry Beyer



USE OF THE BRANCH AND BOUND ALGORITHM  
IN SOLVING TRACK ASSIGNMENT PROBLEMS

Paul Kalata

Department of Electrical and Computer Engineering  
Drexel University  
Philadelphia, Pennsylvania

ABSTRACT

The problem of tracking targets in a dense target environment requires a track/measurement, correlation process which must precede the track filtering updating process. An incorrect assignment can quickly lower the track performance which illustrates the necessity of an optimal correlation process. Also, in a multi-sensor system configuration where tracking is maintained at a central location, the multi-target multi-sensor correlation problem becomes computationally complex. Hence, the need for an optimal but computationally efficient track/measurement algorithm is evident. The use of the Branch and Bound Algorithm has been shown by Birnbaum and Doray to be a feasible process in solving the track assignment problem. In particular when no track/measurement conflicts exist, the algorithm efficiently correlates measurements to tracks. The correlation cost criterion involves predicted distance errors between all measurements and all tracks along with the tracking error covariances. When conflicts exist such as one measurement for two tracks which may occur when targets are close together, a "track splitting" process was proposed. Implementing this process requires an algorithm constraint relaxation. Following review of the multi-target multi-sensor correlation problem and the feasible solution, two study tasks were conducted to: (1) program the Branch and Bound Algorithm in the APL language and apply the track/measurement correlation problem and (2) cast the track/measurement correlation problem in an M-ary decision process. These two tasks were designed to approach the correlation problem from two avenues. The first is a practical and implementable algorithmic solution, the second provides a mathematical basis for the solution. The decision threshold from the latter will be used in the developed algorithm of the former. Follow on work on the multi-target multi-sensor investigation is planned.

Research Colleague at NADC: Dave Birnbaum and Ron Doray

APPLICATION OF PATTERN RECOGNITION TECHNIQUES  
TO AID IN SUBMARINE TRACKING

Robert A. Rubin

Department of Mathematics  
Whittier College  
Whittier, California

ABSTRACT

Methodologies have been investigated for application of statistical pattern recognition techniques as a basis for development of a program for automatic extraction and analysis of significant features from submarine contact data. The results should provide clues for prediction of future target position and, when completed, the proposed new computer program should enhance the application of currently used on-board computer-assisted ASW submarine surveillance programs.

Research Colleague at NADC: Mort Metersky

PRODUCTIVITY ENHANCEMENT AT THE  
NAVY AIRCRAFT REWORK FACILITY

Earl J. Ferguson

Department of Industrial Engineering Management  
Oklahoma State University  
Stillwater, Oklahoma

ABSTRACT

The mission of the Navy Aircraft Rework Facility (NARF) as an organization is a unique one that has no direct counterpart in the civilian world. Although several previous experiments have been conducted by NPRDC to determine the effects of personnel motivational methodologies on productivity at NARF the present study was initiated with the objective of determining better organizational arrangements and other enhancements than those presently existing. Two particular arrangements were investigated -- the first being concentrated on the physical environment at NARF including especially the provisioning and maintenance of the tools of production there and the second being centered on the motivation of the personnel using the tools. Various details and results are discussed and reported.

Research Colleagues at NPRDC: Robert Penn and Bernard Reinland

SIMPLIFYING CONSIDERATIONS  
IN THE  
APPLICATION OF EXPECTANCY THEORY

Donald J. Campbell

Department of Management  
Bowling Green State University  
Bowling Green, Ohio

ABSTRACT

Although Expectancy Theory has provided a valuable conceptual framework for understanding human motivation, the theory's practical usefulness has been hampered by the complexity of its associated questionnaire methodology. This paper argues that such complexity can be reduced by modifying the model to better reflect the cognitive processes thought to underlie motivational decision-making. The paper suggests that these cognitive processes presumably incorporate deterministic rather than probabilistic evaluation procedures, and categorical rather than discrete judgments. Both assumptions are examined and justified, and their implications for Expectancy Theory are explored. Finally, research issues and connections implied by the proposed modification are then considered.

Research Colleague at NRPDC: Robert Penn

CIVILIANS IN THE MILITARY: ISSUES IN  
MILITARY-CIVILIAN RELATIONS

Paul A. Anderson

Department of Social Science  
Carnegie-Mellon University  
Pittsburgh, Pennsylvania

ABSTRACT

Although it is clear that the U.S. military establishment is large, the complexity of its organization and the diversity of its personnel has not been widely appreciated. In addition to employing a large number of people, each service consists of several types of individuals with separate and identifiable goals and interests: political appointees, military officers, enlisted personnel, general schedule employees, federal wage system employees, contractors, and foreign nationals. Organizing a large number of people to perform a task or mission is no easy task and organizing a large number of diverse people is even harder. Various aspects of the problems and issues of importance in military-civilian relations connected with the complexity of the overall organization are examined.

Research Colleague at NPRDC: Robert Penn

VIII. ABSTRACTS OF PARTICIPANTS RESEARCH  
at the  
NAVAL PERSONNEL RESEARCH AND DEVELOPMENT CENTER  
San Diego, California

Program Coordinator at NPRDC: Bernard Rinland

PERFORMANCE OF A VARIABLE CONSTRAINT  
LENGTH VITERBI DECODING ALGORITHM

Jeanne K. Tamaki

Department of Mathematics  
University of Santa Clara  
Santa Clara, California

ABSTRACT

In this paper we investigate the HF channel and analyze the computational complexity of the Viterbi decoding algorithm as the channel varies with time. As the effective constraint length may expand or contract, we have shown that we can expand or contract the state trellis diagram of the Viterbi algorithm accordingly. We have also shown that certain channels have output sequences that cannot be uniquely decoded. Examples of such catastrophic codes are discussed, viz. the channels with equally spaced taps of equal magnitude. An example of a catastrophic code where the taps are of unequal magnitudes is also given.

Research Colleague at NOSC: I. E. Hoff

MODEL AND DESIGN STUDY FOR  
WET END OF  
ADVANCED AUTONOMOUS ARRAY (A<sup>3</sup>)

Robert A. McLauchlan

Department of Mechanical Engineering  
Texas Tech University  
Lubbock, Texas

ABSTRACT

Array tilt and bowing problems found during the October 1980 sea tests of the Advanced Autonomous Array (A<sup>3</sup>) have motivated model development and design study work relevant to this system. A three-dimensional, static equilibrium configuration model for moored cable systems, originally developed by Wang and later modified by McLauchlan, was extended for drifting/free-floating array cable systems. The new model allows the relative velocity mechanism loading the A<sup>3</sup> horizontal line array to be investigated. In addition, the effects of perturbing forces such as negative buoyancy of the array cable segments and/or of the array elements, can be examined for acoustically, etc. worst case profiles. In the design study work three simple linearly-varying-with-depth current velocity cases were considered. These cases were run for the neutrally buoyant nominal design configuration and for three additional negative buoyancy (positive weight in sea water) cases. The design study results indicate that the initial A<sup>3</sup> cable (wet-end) system is poorly designed for low shear (difference between surface and array depth velocities) velocity profiles when negative buoyancy force effects act over the length of the array. In addition, the design study results indicate that for realistic depth-varying current profiles, the simplest, most effective way to reduce array tilt/bowing is by increasing drag  $C_{DA}$  either at or close to the surface.

Research Colleague at NOSC: Tom Higbee



PHYSIOLOGICAL RESPONSES OF MARINE FISH TO  
DISSOLVED ORGANOTIN

Alan G. Heath

Department of Biology  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia

ABSTRACT

The effect of very low concentrations of tributyl tin oxides in water on several physiological functions of fish was investigated in order to gain a better understanding of its action in non-target organisms. Breathing movements, heart rate, blood electrolytes, hemoglobin, hematocrit, blood cell counts, serum protein, and blood acetylcholinesterase activity were measured in two species of harbor dwelling fish. Experiments were conducted in a controlled laboratory setup. Preliminary data suggest a limited respiratory effect, some blood water loss, and anemia in exposed fish. Following completion of the initial investigation by the writer, NOSC staff will continue in a continuing effort gathering data to further define the physiological actions.

Research Colleague at NOSC: George Pickwell

## DESIGN METHODS FOR VLSI SYSTEMS

Rahul Chattergy

Department of Electrical Engineering  
University of Hawaii at Manoa  
Honolulu, Hawaii

### ABSTRACT

Advances in technology for the construction of Very Large Scale Integrated Systems have pointed out the need for the careful design of systems prior to VLSI implementation. VLSI circuit construction is an expensive and time-consuming process. It does not allow for last-minute changes. On the other hand, it enables the designer to provide complex functional capabilities for each subsystem of his design. In order to obtain the best performance from a VLSI realization, a designer must apply a top-down procedure. Special techniques for increasing the reliability of the system must be designed into the system at an early stage. System partitioning must consider the amount of information being transferred among subsystems and attempt to minimize it. Finally, this last consideration leads to a new concept of system partitioning on the basis of information distribution properties which portends radically new system design principles for VLSI systems.

Research Colleagues at NOSC: E. P. Cooper, Reeve Peterson and  
Maniel Vineberg

VII. ABSTRACTS OF PARTICIPANTS RESEARCH  
at the  
NAVAL OCEAN SYSTEMS CENTER  
San Diego, California

Program Coordinator at NOSC: E. P. Cooper

A BRIEF OUTLINE  
OF THE TRANSITION PROBABILITY FUNCTION APPROACH  
TO STOCHASTIC SYSTEMS

James A. Reneke

Department of Mathematical Sciences  
Clemson University  
Clemson, South Carolina

ABSTRACT

Problems of estimation, control, and qualitative analysis for noisy engineering systems can be approached either from the sample path or the transition probability function perspective. This report outlines the latter approach in a series of examples with enough theory included to make the material self-contained. Special attention is given to the relationship between engineering models and Kolmogorov's partial differential equations.

Research Colleague at NCSC: Gerry Dobeck

ON BIAS REDUCTION IN ESTIMATION OF THE  
MAGNITUDE-SQUARED  
COHERENCE FUNCTION

Jae C. Lee

Department of Mathematics and Computer Science  
Moravian College  
Bethlehem, Pennsylvania

ABSTRACT

Current techniques of estimation using the magnitude-squared coherence function -- defined as the ratio of the squared absolute value of the cross spectral density function and the product of the two auto spectra for two zero mean stationary random processes  $X(t)$  and  $Y(t)$  at a given frequency -- rely on partitioning the whole sample into  $N$  equal segments to obtain a reduction in the variance of the estimation. When the positioning is disjoint, the properties of the approximate distribution function of the magnitude-squared coherence function estimator have been studied by many writers. Here a new investigation is directed towards the goal of reducing the bias in the estimation.

Research Colleague at NCSC: D. P. Skinner

A BAYES VIEW OF A LOCALLY OPTIMUM DISCRETE-TIME  
STOCHASTIC SIGNAL DETECTOR

Curtis K. Church

Department of Mathematical Sciences  
University of North Florida  
Jacksonville, Florida

ABSTRACT

A locally optimum discrete-time stochastic signal detector recently proposed by Poor and Thomas which represents the presence of the signal as a change of scale in the noise-only statistics is considered from a Bayesian viewpoint. A solution of Bayes type to the detection hypothesis is given and an example to exemplify its behavior is presented.

Research Colleague at NSCS: Elan Moritz

VI. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL COASTAL SYSTEMS CENTER

Panama City, Florida

Program Coordinator at NCSC: John Wynn

# THE INTEGRATION OF PSL/PSA INTO FASP

Carl W. Schmiedekamp

Department of Mathematical Sciences  
Drexel University  
Philadelphia, Pennsylvania

## ABSTRACT

An effort was initiated to extend the Facility for Automated Software Production (FASP) programming systems to earlier stages of the computer software life-cycle than has previously been possible by including various automated tools for developing systems requirements and functional specifications. The FASP system is a software development system which includes a variety of software design, programming, testing, maintenance, and project management tools. The report describes the user level FASP organization and command-functions recommended for a PSL/PSA-FASP subsystem.

Research Colleague at NADC: John Bergey



PREPARATION OF PLANS AND REPORTS FOR TWO  
HUMAN-COMPUTER INTERACTION RESEARCH PROJECTS

Kenneth H. Funk II

Department of Industrial and General Engineering  
Oregon State University  
Corvallis, Oregon

ABSTRACT

Two documents relating to research on the human-computer interface in the Navy's Pay/Personnel Administrative Support System/Source Data System (PASS/SDS) were prepared. The first developed preliminary information to serve as background material for a future study directed towards improvement of the planned operator interface. The second concerned itself with identifying and correcting sources of errors and delays in use of personnel information systems such as PASS/SDS.

Research Colleagues at NPRDC: James McGrath, John Malone and Ernest Kochler

INSTRUCTIONAL MATERIAL DEVELOPMENT USING  
ARTIFICIAL INTELLIGENCE TECHNIQUES

Christopher K. Riesbeck

Department of Computer Science  
Yale University  
New Haven, Connecticut

ABSTRACT

New work was undertaken, first on the STEAMER Computer-Aided Instruction project directed towards development of new software for a potential new system called the Cromenco Z-2D using the TLC Lisp programming language, and second for the development of new Computer-Aided Instruction methods for training Navy personnel in use of the Navy device known as a Maneuvering Board. Work in the second area is continuing.

Research Colleagues at NPRDC: Jim Hollan and Ed Hutchens

STABILITY OF EVENT RELATED BRAIN  
POTENTIALS

Edwin H. Sasaki

Department of Psychology  
California State University at Bakersfield  
Bakersfield, California

ABSTRACT

A study was run on 23 subjects to investigate the stability of a variety of Event-Related Brain Potentials (ERP), as measured on two occasions one hour apart. Four homologous recording sites on the two hemispheres, and five different sensory and cognitive tasks, were used. Point-by-point cross-correlations were obtained on the ERP wave-forms: (1) between all possible pairs of electrode sites within the two sessions, and (2) between the two sessions for each electrode site. Results provided a complex picture of the stability with which different brain locations respond to different kinds of events.

Research Colleague at NPRDC: G. W. Lewis

IX ABSTRACTS OF PARTICIPANTS RESEARCH  
at the  
NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER  
Annapolis and Carderock, Maryland

Program Coordinator at NSRDC: Elizabeth Cuthill

COMPUTER UTILITY PROGRAMS FOR THE METALS DIVISION  
AT THE NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Patrick G. Barber

Department of Chemistry  
Longwood College  
Farmville, Virginia

ABSTRACT

In order to facilitate the analysis of engineering data obtained in the metals division at NSRDC in Annapolis, Maryland, two computer programs were written. The first accepts creep data, displays that data in tabular and graphical forms, allows for any input errors to be corrected, performs two linear least-square calculations, and obtains the parameters giving the best fit for an equation which describes creep in metals. The program further allows the display of the data in both tabular and graphical forms, since such displays permit a rapid visual check of the reliability of fit and accuracy of the analysis. The results of this program were verified by analyzing data both by hand-and-eye and by the computer program. The second program for data analysis was designed to provide a statistical analysis of crack extension experiments which were run according to ASTM standards by several laboratories. This program statistically analyzed the data to ascertain the reliability of data obtained by these different laboratories and to determine if modifications in the existing standards were needed. In addition to the above two programs for data reduction and analysis, general utilities programs were also developed for; (1) maintenance of an in-house literature file on experimental information and technical reports; (2) for maintenance of an inventory of small items such as chemicals; (3) for plotting that accepts data and displays it using primary and secondary axis labels; and (4) for display of any function as a variable automatically changes. These computer programs are written in BASIC and run on a Tektronix Microcomputer with 32K bytes of memory. They run using either tape or disc formats, and use of a plotter is an option for the preparation of hardcopies of the graphs.

Research Colleague at NSRDC: John Gudas

# ACOUSTICS AND VIBRATION OF LIQUID-FILLED PIPING

Frank J. Hatfield

Department of Civil Engineering  
Michigan State University  
East Lansing, Michigan

## ABSTRACT

A study was mounted of component synthesis methods for acoustical and vibration analysis of two particular pipe systems. The first step of the component synthesis was determination of the normal modes of the pipe structure, with no consideration of elastic properties of the liquid. This was done using a NASTRAN finite element program. Although a general purpose computer program for the second step of component synthesis previously had been written, that program required utility routines not available at NSRDC. Therefore, special purpose programs were written to handle the second step. These programs produced plotted results. Incidental to the analyses an investigation was made of the magnitude of centrifugal forces on pipe bends due to oscillation of the contained liquid, the reduction of stiffness of pipe bends due to distortion of cross section during bending, the upper frequency limit on plane-wave acoustics imposed by the first lobar mode of the pipe cross section, and the sensitivities of component synthesis results to the number of elements used in the finite element model of the pipe structure and to the number of normal modes carried from the first to second steps. For the two pipe systems the results demonstrated that analysis by component synthesis was as accurate as formulation and solution of differential equations of motion. For the more complicated system, which involved three dimensions and three bends comprising 36 percent of the total pipe system length, both analysis methods show need for refinement. It was concluded that research on the acoustic and mechanical behavior of bends and other pipe fittings is needed in order to reduce the dependence of analysis on assumptions.

Research Colleague at NSRDC: David Goldsmith

# ACOUSTIC EMISSION STUDIES USING A DIGITAL STORAGE OSCILLOSCOPE

Narayan R. Joshi

Engineering and Physics Program  
Coppin State College  
Baltimore, Maryland

## ABSTRACT

Acoustic emissions from materials under stress are of a short transient nature which therefore poses the problem in their observation of checking their reproducibility during the test procedure. Here the experimental system for observing the signals consisted of the test specimen under stress loading, the transducer picking up the acoustic emission signals, the acoustic emission counts recording device and the display oscilloscope. To circumvent the reproducibility problem noted, a digital storage oscilloscope was used in the experimental set up along with conventional cumulative count measuring equipment such as AET Model 204A. The repeated step loading was achieved by breaking the pencil lead on the blocks of metal, epoxy and graphite/epoxy composite, to standardize the system by using the stored acoustic emission patterns. The experimental system was subsequently used to study acoustic emission activity, from three composite plates with different ply orientations under point loading.

Research Colleague at NSRDC: Alex Macanders

AUTOMATIC GENERATION OF A FINITE  
ELEMENT MESH WITH DIFFERENT NUMBERS  
OF ELEMENTS ON EACH SIDE

Letitia J. Korbly

Department of Mathematics  
University of Alabama in Birmingham  
Birmingham, Alabama

ABSTRACT

This report is on the automatic generation of a finite element mesh which changes density in both directions. The algorithm generates a triangular mesh with a different number of elements on each side of a surface. It does this by triangularizing the underlying parameter space. The elements are reasonable looking, though some of them have obtuse angles. This algorithm is implemented as a GPRIME subroutine on the CYBER 74 at NSRDC in Carderock, Maryland. As implemented, to apply, the algorithm, it is only necessary to define the surface, call the subroutine with a single command, and key in the number of elements on each side of the surface.

Research Colleagues at NSRDC: Sandy Dhir and Jim McKee



FINITE DIFFERENCE COMPUTATIONS FOR A TWO-DIMENSIONAL  
HYDROFOIL BELOW A FREE SURFACE

L. A. Kurtz

Department of Mathematics  
University of Montevallo  
Montevallo, Alabama

ABSTRACT

A study was undertaken of finite difference computational methods for application to the problem of free-surface potential flow generated by a submerged hydrofoil using boundary-fitted coordinates. The difficulty involved with finite difference solutions at the boundary was avoided by employing a transformation whereby the coordinate lines are in fact coincident with the boundary. The flow problem itself was a free-surface initial boundary value problem with nonlinear free surface conditions. The problem was considered to be one of potential flow complicated by the Kutta condition which requires that the steady-state velocities on either side of the hydrofoil trailing edge, be equal. As the solution evolved at each time step the nonlinear boundary conditions required that the coordinate transformation equations be coupled with the potential flow equations and also with an equation which accounts for the Kutta condition. Work on the problem is continuing.

Research Colleague at NSRDC: H. S. Haussling

INTERACTIVE CONTROL PANEL GRAPHICS,  
A THREE DIMENSIONAL GRAPHICS PACKAGE  
AND THE TRACKER PROBLEM

Jay J. Thomas

Department of Mathematics  
University of Missouri  
Columbia, Missouri

ABSTRACT

As suggested by the title, the report is subdivided into three parts as follows: Interactive Control Panel Graphics, a Three Dimensional Graphics Package and the Tracker Problem. The Interactive Control Panel Graphics and the Three Dimensional Graphics package are essentially complete, but as with all projects, modifications can be implemented in the future to improve or change the performance of the resulting programs. Some such potentially useful modifications are suggested in the report. Work on the Tracker Problem is partially complete and planned directions for continued work are outlined.

Research Colleagues at NSRDC: William Smith and Thomas Moran

MICROPROCESSOR CONTROL OF VIDEO  
CAPTURE, TRANSFER AND MOTOR DYNAMICS

Matthew J. Yuschik

Department of Electrical and Computer Engineering  
University of South Carolina  
Columbia, South Carolina

ABSTRACT

An investigation was undertaken of microprocessor control techniques for application to the problems of video capture, information transfer and camera motor dynamics in the problem of video information acquisition. The use of a programmable device enables significant flexibility to be achieved in this, the first stage of any pattern recognition system. With the particular model presented, a large number of parametric variations can be easily examined under computer software control. A detailed account of the work is presented.

Research Colleagues at NSRDC: Jim Carlberg and Pat Marques

X. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL SURFACE WEAPONS CENTER

Silver Spring, Maryland

and

Dahlgren, Virginia

Program Coordinator at NSWC: Wendell Anderson

NUCLEAR WEAPONS EFFECTS  
AT HIGH ALTITUDES

John G. Foll

Department of Physics and Earth Sciences  
Lenoir - Rhyne College  
Hickory, North Carolina

ABSTRACT

A computer modeling investigation of high altitude nuclear weapons effects on missile electronics was undertaken. Initial work was concentrated on the effects of gamma ray emission and neutron fluence. A previous model was up-dated to include new atmospheric data, and new gamma ray sources and to incorporate new improved gamma ray transport calculations. Applications to Navy missile hardness requirements studies are anticipated.

Research Colleagues at NSWC: Fred Warnock

REPORT ON 3,3-DINITROALKANOLS  
SYNTHESIS

Luis A. Rivera

Department of Chemistry  
Cayey University College  
University of Puerto Rico  
Cayey, Puerto Rico

ABSTRACT

A study was initiated with the objective of devising an improved or better synthetic route to 3,3,3-trinitro propanol and 3,3 dinitropropanols for which a moderate yield is obtained through a several step sequence starting from the corresponding carboxylic acid. Various details and results are reported.

Research Colleague at NSWC: H. G. Adolph

### XIII. CUMULATIVE COMPILATION OF DATA ON LATER RESEARCH FALLOUTS FROM THE 1979 AND 1980 PROGRAMS

#### Plan and Procedure

As noted in the Introduction and Executive Summary an important part of the objectives of the NSFRP program has been to develop continuing research of Navy interest at the participating faculty members colleges and universities and to establish continuing technical relations among college and university faculty members and their professional scientific and engineering peers in the Navy laboratories.

In an effort to determine to what extent the NSFRP programs have been successful in this regard, plans for tracking the Navy related activities and research of former NSFRP participants have been established. Accordingly, beginning with this report we have polled the NSFRP participants and the Navy laboratory Program Coordinators from the 1979 and 1980 programs to determine what Navy related technical activities of the NSFRP participants took place subsequent to their summer's experience at the Navy laboratories which were brought about, stimulated, or otherwise made possible, as a result of their experience under the NSFRP programs.

Significant highlights of these "research fallout" as we term them are summarized below for the 1979 and 1980 programs and in future years similar fallout from the 1981 and later NSFRP programs will be tracked -- for inclusion in future reports -- along with any new fallout from the 1979 and 1980 programs as they occur.

#### Research Fallout and Activities

The types of research fallout from the NSFRP programs which have thus far been identified fall more or less into three categories which we may describe as: (i) research contracts, (ii) research papers and (iii) later Navy employment or other working relationships which have developed between former NSFRP participants and the Navy laboratories.

Among the research fallout from the 1979 NSFRP program we may note the following items of interest:

- o 8 Research contracts totalling about 184,000 dollars have been awarded to five former 1979 NSFRP fellows as a result of the program;
- o 7 Papers have been given as invited addressees or have been published in referred journals and several more are still planned or are in preparation as a result of work started under the 1979 program;

ULTRAVIOLET ENHANCED DEPOSITION OF THIN  
FILMS FROM PENTACARBONYL-IRON ON  
GALLIUM ARSENIDE, QUARTZ AND SAPPHIRE

Peter J. Walsh

Department of Physics  
Fairleigh Dickinson University  
Teaneck, New Jersey

ABSTRACT

The potential utilization of organo-metals in the thin-film disposition of metals, semiconductors, and insulators onto various substrates is assessed. The emphasis is on the particular advantages of the ultraviolet photolysis of organo-metals using incoherent light for low temperature, wide-area deposition of thin films. Experimental results on the photolysis and pyrolysis of pentacarbonyl-iron on gallium arsenide, quartz, and sapphire are reported.

Research Colleague at NWC: N. Bottka



INTRINSIC AND SURFACE ROUGHNESS INDUCED ABSORPTION ELECTROMAGNETIC  
RADIATION BY METALS

C. C. Sung

Department of Physics  
University of Alabama  
Huntsville, Alabama

ABSTRACT

The effect of the surface roughness of a metallic surface as a cause of additional absorption for incident electromagnetic waves was investigated. A random rough surface and a surface with periodic and V-shaped profile with specific application to the diamond-turned surfaces were used in the study. Numerical results for various surface characteristic parameters and wave lengths were obtained and their importance was compared with the intrinsic or bulk, absorption. The surface roughness induced absorption was found to be large for a surface with a periodic structure of high spatial frequency component. If this kind of structure can be eliminated, the surface roughness induced absorption will, in general, be only a few percent of the intrinsic part for a typical diamond-turned surface.

Research Colleague at NWC: M. Elson

SYNTHESIS OF HIGH DENSITY/HIGH ENERGY  
MOLECULES AND SYNTHESIS OF NEW  
POLYCYCLIC HYDROCARBON SYSTEMS

Alan P. Marchand

Department of Chemistry  
University of Oklahoma  
Norman, Oklahoma

ABSTRACT

An investigation was mounted in the research area of synthesis of high density hydrocarbon fuels and, particularly, of synthesis of C-nitro and N-nitro containing cage compounds which are of interest in connection with other on-going research on propellants and explosives. Various details on procedures and results of the investigation are presented.

Research Colleague at NWC: A. T. Nielsen

GAS CHROMATOGRAPHY - MASS SPECTROMETRY ANALYSIS OF  
ORGANIC PRODUCTS DERIVED FROM BURNING MISSILES

Dorothy C. Lane

Department of Chemistry  
University of Virginia  
Charlottesville, Virginia

ABSTRACT

For some time NWC has been exploring environmentally safe methods for disposing of obsolete and unusable rockets and missiles. Among the methods under investigation is burning the devices which then gives rise to the release of a number of organic compounds, the nature of which became the subject of the present study. Organic combustion products were collected on tenax, extracted, and subsequently analyzed via gas chromatography - mass spectrometry. Of particular interest is the identification of polycyclic aromatic hydrocarbons using computer-assisted direct and reverse searches of the mass spectra within the gas chromatographs. A number of other compounds, including some associated with tenax decomposition, were observed.

Research Colleague at NWC: Carl Heller

## OPTICAL EMISSOMETRY OF SOLIDS

Lawrence H. Johnston

Department of Physics  
University of Idaho  
Moscow, Idaho

### ABSTRACT

An optical device, originally designed for somewhat different purposes, was modified and rebuilt for use in measurement of the thermal emissivity of various optical window and mirror materials applicable in the infrared region from 2.5 to 14 micrometers wavelength. Measurements using the reconstructed device are planned in the future.

Research Colleague at NWC: Harold Bennett

XII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL WEAPONS CENTER

China Lake, California

Program Coordinator at NWC: Dick Wisdom

## SPECULAR DECOMPOSITION BEAMFORMING

Lester R. Le Blanc

Department of Ocean Engineering  
University of Rhode Island  
Kingston, Rhode Island

### ABSTRACT

The method of principal component beamforming described in this paper is an array data reduction method that allows one to observe the statistically independent components of wave energy arriving at the array. A model of isotropic noise and incident,, bandlimited plane waves is used to study array resolution and bandwidth effects. In all cases studied the technique provides a maximum spatial information analysis method for the observer.

Research Colleague at NUSC: John Short

FEASIBILITY OF VARIOUS HIGH SPEED FIBER OPTIC  
LINK TECHNIQUES FOR A REMOTE RF SENSOR CONCEPT

Allen Dean Drake

Department of Electrical Engineering and Computer Science  
University of Connecticut  
Storrs, Connecticut

ABSTRACT

This report evaluates various means for implementing an RF fiber optic link and makes an evaluation of what would be most feasible and yet technologically advanced. Wavelength (0.85  $\mu\text{m}$  versus 1.3  $\mu\text{m}$  versus 1.55  $\mu\text{m}$ ), type of fiber (single mode versus graded-index), sources (LEDs versus ILDs), detectors (PINs versus APDs), and modulation schemes are all examined, and a final recommendation is made.

Research Colleague at NUSC: F. O. Allard

STRUCTURAL ANALYSIS  
OF  
TORPEDO COMPONENTS

Peter B. Cooper

Department of Civil Engineering  
Kansas State University  
Manhattan, Kansas

ABSTRACT

A torpedo component structural analysis was made of: (1) the aluminum alloy transducer array plate; (2) the metal matrix composite bulkhead and (3) the extended range exercise shell. A finite element analysis of the array plate had been completed previously and the new work was limited to participation in the laboratory tests. Work on both the bulkhead and the exercise shell included also formulation of recommendations on instrumentation for future laboratory tests, and the carrying out of certain analytical studies.

Research Colleague at NUSC: Bruce Sandman



## COMPOSITE MATERIALS

Henry R. Busby, Jr.

Department of Mechanical Engineering and Applied Mechanics  
North Dakota State University  
Fargo, North Dakota

### ABSTRACT

The objective of the summer study of composite materials was to develop a series of lecture notes on composite materials, generate video tapes based on the lecture notes and to help investigate a composite rubber sonar dome. It is most desirable that the present day engineer understand the materials science aspects and the micromechanics of composite materials. Because composite materials are nonhomogeneous, anisotropic and difficult to characterize, a more sophisticated and better background is required to analyze with problems involving such materials than is the case with more ordinary materials. A great deal of re-learning is necessary on the problems involving part of personnel previously engaged in working with, and accustomed to, isotropic design and analysis. Accordingly, the summer study attempted to lay a new theoretical foundation -- well separated from the concepts of homogeneous and isotropic materials -- for the more difficult nonhomogeneous, anisotropic concepts encountered in composite materials engineering.

Research Colleague at NUSC: A. D. Carlson

# HIGH FREQUENCY TEMPERATURE FLUCTUATIONS NEAR BERMUDA

W. F. Ahrnsbrak

Department of Geoscience  
Hobart and William Smith Colleges  
Geneva, New York

## ABSTRACT

Two phenomena are presented which appear to be inconsistent with the theory that organized periodic water movement is limited to frequencies lower than the Brunt-Vaisala frequency ( $N$ ). Persistent, recognizable peaks at frequencies higher than  $N$  are shown to exist in variance spectra of temperature time series near Bermuda. Temperatures were recorded at one minute intervals from a sensor moored near the base of the permanent thermocline (approximately 1200 m.) south of Bermuda. Spectra were calculated for segments of the record 17.07 hours (1024 data points) long, beginning every 12 hours, and yield power densities for frequencies from  $0.001 \text{ min}^{-1}$  to  $0.5 \text{ min}^{-1}$  ( $N \approx 0.01 \text{ min}^{-1}$ ). While any one spectrum contains no significant peaks at frequencies higher than  $N$ , successive spectra show recognizable peaks at the same frequency persisting for periods of up to five days duration. These "bursts" do not occur at any one unique frequency. A periodicity, of about 10 to 12 days, is also evident in the time series of the integral (over the whole spectrum) of the power densities. This "pulsing" is also seen by examining the successive spectra of 17 hour segments of the time series rather than by assuming stationarity and computing the spectrum of the whole series.

Research Colleague at NUSC: J. M. Syck

XI. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL UNDERWATER SYSTEMS CENTER

Newport, Rhode Island

and

New London, Connecticut

Program Coordinator at NUSC: Paul Scully - Power

## PROLATE SPHEROIDAL MAGNETIC QUADRUPOLES

Wesley W. Shelton, Jr.

Department of Electrical and Computer Engineering  
Florida Institute of Technology  
Melbourne, Florida

### ABSTRACT

Two existing sets of dissimilar mathematical expressions for magnetic quadrupole field intensities in the prolate spheroidal coordinate system were examined for authenticity. It was determined that the two sets were generated via different methods. Thus one set was generated by differentiating the quadrupole potential terms in the prolate spheroidal harmonic expansion of the magnetic scalar potential and the other arose through two differentiations of the magnetic dipole potential terms in the same expansion. The former method is conceptually proper whereas the latter technique, though permissible under some circumstances, fails to provide the correct quadrupole expression in the prolate spheroidal coordinate system.

Research Colleagues at NSWC: W. A. Menzel and J. Holmes

- o 2 Former 1979 NSFRP fellows have held Navy intergovernmental personnel act appointments at NRL and NSRDC in subsequent summers or on a continuing one-day-a-week basis;
- o 1 Former 1979 NSFRP fellow has been employed as an intermittent Navy civil servant on a continuing one-day-a-week basis at NRL since completion of his summer appointment;
- o 1 Former 1979 NSFRP fellow based his doctoral dissertation on work started under the program and completed his thesis and PhD while supported by follow-on Navy contracts resulting from the program;
- o 1 Former 1979 NSFRP fellow has become a full time Navy civil servant at NSWC.

And from the 1980 NSFRP program we may note similarly the following fallouts:

- o 4 Research contracts totalling about 106,000 dollars have been awarded to four former 1980 NSFRP fellows as a result of the program;
- o 7 Papers have been presented as invited addresses or have been submitted or accepted by referred journals, and others are still planned or in preparation as a result of work started under the 1980 program;
- o 1 Former 1980 NSFRP fellow has subsequently been employed as a summer temporary Navy civil servant at NJSC following his initial year in the program;
- o 1 Former 1980 NSFRP fellow has subsequently been employed on a continuing one-day-a-week basis as a temporary Navy civil servant at NSWC since completion of his summer appointment.

Further specifics about the research contracts awarded as follow-ons from the 1979 and 1980 NSFRP programs are listed in Tables IV and V along with the names of the 1979 and 1980 NSFRP participants, their college or university affiliations and the Navy laboratories with which they had been associated under the 1979 and 1980 programs.

Table IV

RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1979 PROGRAM WITH  
FUNDING IN THOUSANDS OF DOLLARS

<u>Participant</u>	<u>Academic Department</u>	<u>College/ University</u>	<u>Contract No.</u>	<u>Funding</u>	<u>Laboratory</u>
Bowman, T.T.	Mathematics	U Florida	N00167-79-M-4321	10	NSRDC
Cramer, M.S.	Eng Sci & Mech	VPI	N00173-80-M-7172	10	NRL
			N00014-81-C-2286	3	
			N00014-81-C-2314	14	
Pollack, G.L.	Physics	Michigan State	N00014-80-C-0617	82	NMRI
Vawter, D.L.	Eng Sci & Mech	VPI	N00014-81-K-0126	45	NMRI
Young, C.T.	Mech Engineering	OK State	N00167-80-M-0333	10	NSRDC
			N00167-81-M-6260	10	

Total funding for 1979 research contract fallouts in thousands of dollars-----184

Table V

RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1980 PROGRAM WITH  
FUNDING IN THOUSANDS OF DOLLARS

<u>Participant</u>	<u>Academic Department</u>	<u>College/ University</u>	<u>Contract No.</u>	<u>Funding</u>	<u>Laboratory</u>
Busby, H.R.	Mech Engineering	N D State	N00140-81-M-DZ14	5	NUSC
Dube, R.L.	Elect Engineering	W New England	N00140-81-M-FZ73	10	NUSC
Gilmore, C.M.	Engineering	GWU	N00019-80-C-0403	56	NRL
Johnson, D.H.	Elect Engineering	Rice U	N00014-81-K-0565	<u>35</u>	NOSC

Total funding for 1980 research contract fallouts in thousands of dollars---106

Recalling that the 1979 NSFRP program involved only 16 participants and the 1980 program supported only 26, it follows from the data presented in the foregoing, that a substantial fraction of the two year's participants had some subsequent technical relation with the Navy as a result of the 1979 and 1980 programs. Thus, lumping the two programs together, 9 out of 42 participants in 1979 and 1980 had follow-on contracts with the Navy while 5 others subsequently held intergovernment personnel act appointments or temporary civil service appointments with the Navy and one former participant became a full time civil servant and Navy scientist.

No attempt has yet been made to track the research fallouts from the 1981 NSFRP program, it being judged too early yet for a reasonably full list of such fallouts to be practical to compile. As noted above, however, fallouts from the 1981 program and from later NSFRP programs as well as any new fallouts that may yet develop from the 1979 and 1980 programs will be tracked in the future as they occur and will be documented in future reports.



#### XIV. OUTLINE OF PLANS FOR THE FUTURE

##### Plans for 1982

As presently planned the 1982 NSFRP program will bring about 100 faculty members to the 10 participating Navy laboratories with somewhat less than half of them supported by ONR. No new Navy laboratories will be added to the program but the Navy laboratory support for the program is anticipated to increase quite substantially in accordance with these estimates.

For the 1982 program, the participants will be paid 5500 dollars each, which represents about a 22 percent increase over the 1981 stipends of 4500 dollars per participant.

The academic pool of applicants from which the 1982 program participants will be selected appears also to be broadening with more scientists having applied to the 1982 program from the larger American universities and technological institutes than in previous years.

##### Plans for Continued Tracking of Research Fallout

As already noted, future occurring "research fallout" of Navy interest arising from later activities of former 1979, 1980 and 1981 NSFRP participants will continue to be tracked and will be reported in the 1982 Annual Report on a cumulative basis as herein and this procedure will be followed in all subsequent Annual Reports on NSFRP programs.

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